

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

PCT

To:

see form PCT/ISA/220

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY (PCT Rule 43bis.1)

Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No.
PCT/GB2004/002663

International filing date (day/month/year)
21.06.2004

Priority date (day/month/year)
21.06.2003

International Patent Classification (IPC) or both national classification and IPC
H02P6/08

Applicant
WEATHERFORD/LAMB, INC.

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☒ Box No. II Priority
- ☒ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☒ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA"). However, this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1 bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of three months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA:



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WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITYInternational application No.
PCT/GB2004/002663

IAP20 Rec'd PCT/PTO 21 DEC 2005

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
 - ☐ This opinion has been established on the basis of a translation from the original language into the following language , which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).
2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:
 - a. type of material:
 - ☐ a sequence listing
 - ☐ table(s) related to the sequence listing
 - b. format of material:
 - ☐ in written format
 - ☐ in computer readable form
 - c. time of filing/furnishing:
 - ☐ contained in the international application as filed.
 - ☐ filed together with the international application in computer readable form.
 - ☐ furnished subsequently to this Authority for the purposes of search.
3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments:

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.
PCT/GB2004/002663

Box No. II Priority

1. ☒ The following document has not been furnished:

☒ copy of the earlier application whose priority has been claimed (Rule 43*bis*.1 and 66.7(a)).

☐ translation of the earlier application whose priority has been claimed (Rule 43*bis*.1 and 66.7(b)).

Consequently it has not been possible to consider the validity of the priority claim. This opinion has nevertheless been established on the assumption that the relevant date is the claimed priority date.

2. ☐ This opinion has been established as if no priority had been claimed due to the fact that the priority claim has been found invalid (Rules 43*bis*.1 and 64.1). Thus for the purposes of this opinion, the international filing date indicated above is considered to be the relevant date.

3. ☐ It has not been possible to consider the validity of the priority claim because a copy of the priority document was not available to the ISA at the time that the search was conducted (Rule 17.1). This opinion has nevertheless been established on the assumption that the relevant date is the claimed priority date.

4. Additional observations, if necessary:

Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non obvious), or to be industrially applicable have not been examined in respect of:

☐ the entire international application,

☒ claims Nos. 6-29

because:

☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (*specify*):

☐ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. are so unclear that no meaningful opinion could be formed (*specify*):

☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

☒ no international search report has been established for the whole application or for said claims Nos. 6-29

☐ the nucleotide and/or amino acid sequence listing does not comply with the standard provided for in Annex C of the Administrative Instructions in that:

the written form

☐ has not been furnished

☐ does not comply with the standard

the computer readable form

☐ has not been furnished

☐ does not comply with the standard

☐ the tables related to the nucleotide and/or amino acid sequence listing, if in computer readable form only, do not comply with the technical requirements provided for in Annex C-bis of the Administrative Instructions.

☐ See separate sheet for further details

Box No. IV Lack of unity of invention

1. ☒ In response to the invitation (Form PCT/ISA/206) to pay additional fees, the applicant has:
- ☐ paid additional fees.
 - ☐ paid additional fees under protest.
 - ☒ not paid additional fees.
2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose not to invite the applicant to pay additional fees.
3. This Authority considers that the requirement of unity of invention in accordance with Rule 13.1, 13.2 and 13.3 is
- ☐ complied with
 - ☒ not complied with for the following reasons:
see separate sheet
4. Consequently, this report has been established in respect of the following parts of the international application:
- ☐ all parts.
 - ☒ the parts relating to claims Nos. 3

Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	3
	No: Claims	1,2,4,5
Inventive step (IS)	Yes: Claims	
	No: Claims	1-5
Industrial applicability (IA)	Yes: Claims	1-5
	No: Claims	

2. Citations and explanations

see separate sheet

The following document is referred to in this communication:

D1: PATENT ABSTRACTS OF JAPAN vol. 2003, no. 05, 12 May 2003 (2003-05-12) & JP 2003 003985 A (MITSUBISHI HEAVY IND LTD), 8 January 2003 (2003-01-08)

See also automatic translation of JP 2003 003985 A on
http://www.ipdl.jpo.go.jp/homepg_e.ipdl/

D2: SUNG-JUN KIM ET AL: "A novel filter design for suppression of high voltage gradient in voltage-fed PWM inverter" APPLIED POWER ELECTRONICS CONFERENCE AND EXPOSITION, 1997. APEC '97 CONFERENCE PROCEEDINGS 1997., TWELFTH ANNUAL ATLANTA, GA, USA 23-27 FEB. 1997, NEW YORK, NY, USA, IEEE, US, 23 February 1997 (1997-02-23), pages 122-127, XP010215809 ISBN: 0-7803-3704-2

Re Item IV.

1 - The separate inventions are:

Claim 3 :

Electric submersible pump having filtering means

Claims 6-17 :

Drive circuit with a variable voltage source

Claims 18,20 :

Drive circuit having means for minimising the output power of the drive circuit at a fixed speed

Claims 19,21,22 :

Drive circuit with means for maximising the motor speed for a given output power

Claims 23-25 :

Downhole permanent magnet motor having an annular gap such that the fluid flow is turbulent during rotation of the rotor above a critical speed

Claims 26-29 :

Downhole motor having a bearing with spiral grooving

They are not so linked as to form a single general inventive concept (Rule 13.1 PCT) for the following reasons:

- 1.1 - Document D1 discloses all the features of claims 1,2,4,5 : it describes an electric submersible pump ([0001]) containing an AC permanent magnet synchronous motor ([0006]) having three phases and drive means for supplying drive signals to all the phases of the motor at the same time, each signal being constituted by a cyclically smoothly varying voltage applied to the corresponding motor phase during driving of the motor ([0026]).

The drive circuit of D1 generates PWM voltages that are applied to the phases of the synchronous motor. Due to the fact that the electric motor is a synchronous motor, it is implicit that drive signals are varying cyclically and that they are supplied to all three phases at the same time. Furthermore, the motor windings act like a filter so that the voltage signals are varying "smoothly".

Furthermore, D1 discloses also a drive circuit for an electric submersible pump, comprising means for generating cyclically varying waveforms (Fig.4, Ref.63), and output means (power supply cable C, [0026]) for applying said waveforms to energise a plurality of phases of the pump motor.

The other technical feature of claim 4 is unclear to the examiner: the word "smoothly" is unclear because the technical features defined in lines 20-24 describe a PWM waveform and not a filtered PWM waveform. Therefore, the "means" correspond only to the inverter.

- 1.2 - Claim 3 defines that the pump comprises filter means . That feature is not known from D1. Therefore, it is considered to be the special technical feature (STF) of the first subject.

That feature solves the problem of removing damaging transients at the motor terminals and reduce torsional vibrations (application p.30, l.31-p.31, l.2 and p.32, l.20-25).

- 1.3 - Claims 6-17 differ from D1 in that the drive circuit comprises a variable voltage

source. That feature is considered to be the STF of the second subject.

It solves the problem of reducing switching losses and avoid transformers (application p.34, I.8-9 and p.33, I.29-31).

- 1.4 - Claims 18,20 differ from D1 in that the drive circuit comprises means for minimising the output power of the drive circuit at a fixed speed. That feature is considered to be the STF of the third subject.

It solves the problem of minimising the output power of the drive circuit (application p.41 I.6-9).

- 1.5 - Claims 19,21,22 differ from D1 in that the drive circuit comprises means for maximising the motor speed for a given output power. That feature is considered to be the STF of the fourth subject.

It solves also the problem of minimising the output power of the drive circuit (application p.43 I.1-6), but it is an alternative solution to the one of 1.4.

- 1.6 - Claims 23-25 define a downhole permanent magnet motor having an annular gap such that the fluid flow is turbulent during rotation of the rotor above a critical speed. That feature is considered to be the STF of the fifth subject.

It solves the problem of heat transfer between the rotor and the stator (application p.13, I.32-p.14, I.2).

- 1.7 - Claims 26-29 define a downhole motor having a bearing with spiral grooving. That feature is considered to be the STF of the sixth subject.

It solves the problem of bearing stability (claim 26).

- 2.1 - The applicant cites the problem of motor power versus motor length as the general problem that must be solved (p.1, I.20-29). That problem is very common (see D1) and can not be seen as a common inventive concept.

- 2.2 - The features described in 1.2 to 1.7 are different and have no technical relationship. They are also not corresponding since they solve different problems

that can't be linked by a common inventive concept. Therefore, the requirements of unity of invention are not fulfilled.

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Novelty

1 - The present application does not meet the requirements of Article 33(1) PCT, because the subject-matter of claims 1,2,4,5 is not new in the sense of Article 33(2) PCT.

1.1 - For reasons, see Item IV, § 1.1

Inventive Step

2 - The present application does not meet the requirements of Article 33(1) PCT, because the subject-matter of claim 3 does not involve an inventive step in the sense of Article 33(3) PCT.

2.1 - Filtering means for reducing overvoltages are well known as can be seen from D2. The skilled person would use a filter for reducing voltage gradients in the submersible pump of D1 without making use of inventive skills.